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Synergy Of Product Innovation And Operational Efficiency On The Market Value Of Go-Public Startup Companies

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ABSTRACT

Startups that have gone public face the challenge of balancing innovation investment with operational efficiency in order to enhance firm market value. This study examines the effect of product innovation, proxied by R&D intensity, on the market value of publicly listed startup firms, with operational efficiency as a mediating variable. The study employs a quantitative explanatory design using secondary data from the financial statements and annual reports of six publicly listed startup companies during 2021–2025, resulting in 30 firm-year observations. The hypotheses are tested consistently using partial least squares structural equation modeling (PLS-SEM), covering direct and indirect effects among the research variables. The results indicate that product innovation has a positive and significant effect on operational efficiency. Operational efficiency also has a positive and significant effect on firm market value, as measured by Tobin's Q. However, the direct effect of product innovation on market value is not statistically significant. The Sobel test confirms that operational efficiency significantly mediates the relationship between product innovation and market value. These findings indicate that innovation investment creates market value primarily when it is converted into measurable operational improvements. This study contributes to innovation management and corporate finance literature by demonstrating an indirect value-creation mechanism: R&D intensity functions as a strategic resource, while operational efficiency represents the organizational capability that converts this resource into market value. Practically, the findings encourage startup managers and investors to evaluate innovation spending together with evidence of asset utilization, process improvement, and operational discipline in the post-IPO period.

Keyword: *market value; operational efficiency; product innovation; publicly listed startups; R&D intensity.*

INTRODUCTION

Startup companies that have made initial public offerings (IPOs) are facing significant changes in the strategic environment. In the pre-IPO phase, companies are generally more oriented towards growth, market expansion, and strengthening innovation to build business legitimacy. However, after becoming a public company, startups are not only required to continue to innovate, but must also be able to demonstrate operational efficiency, governance quality, and a company's value prospects that convince investors. In this context, product

innovation represented through research and development intensity (R&D intensity) is an important variable because it reflects the company's seriousness in developing products, technology, and long-term competitive advantage. However, R&D investments also contain large costs, risk of uncertainty, and lag time of benefits, so their impact on market value is not always immediately apparent in the post-IPO period (Black et al., 2025; Ghafar Ali et al., 2025; Wang et al., 2022).

Previous literature has shown that the relationship between innovation and company value still yields mixed findings. A number of studies have stated that R&D intensity can increase a company's valuation as the market views innovation as a signal of future growth, intangible asset creation capacity, and higher commercialization opportunities. However, other studies show that R&D spending can actually suppress short-term performance due to increased operational costs, uncertainty about monetizing innovation, and suboptimal internal management of companies. (Ghafar Ali et al., 2025) found that R&D spending can reduce short-term profitability despite potentially increasing market value in the long term, while (Wang et al., 2022) affirmed the trade-off between financing, innovation, and productivity in the transition phase to public companies. On the other hand, (Black et al., 2025) show that the value of innovation is more likely to be appreciated by the market when the company is able to demonstrate the credibility of the technology and the prospects of post-IPO commercialization. The inconsistency of the findings suggests that the influence of innovation on market value cannot yet be fully explained through direct relationships alone.

One relevant explanation is that new innovations will have an economic impact if the company is able to turn them into operational efficiencies. Operational efficiency represents a company's ability to manage inputs, improve processes, reduce waste, and produce more optimal output. In the context of go-public startups, operational efficiency is becoming increasingly important as the market not only assesses the capacity to explore innovation, but also the company's ability to organize the cost structure, productivity, and sustainability of operations after obtaining funds from the capital market. Several studies have shown that R&D intensity can improve operational efficiency through process improvement, strengthening absorptive capacity, and utilizing external knowledge to accelerate product development and commercialization of innovations (Chang et al., 2024; Gautam & Gautam, 2024; Wulandari & Onuegbu, 2024). Thus, operational efficiency is not only worthy of being placed as an outcome of innovation, but also as an intervening mechanism that explains how innovation investment translates into performance that is positively assessed by the market.

From a capital market perspective, operational efficiency also has strategic significance because it is directly related to investors' perception of management quality, cash flow stability, and the company's ability to sustain growth. Startups that are able to demonstrate operational efficiency tend to be seen as more ready to transition from the exploration phase to the sustainable exploitation phase. Previous studies have confirmed that operational efficiencies can strengthen profitability, lower operational uncertainty, and increase market confidence in a company's ability to create long-term value (Black et al., 2025; Guo et al., 2022; Kumari & Mishra, 2021). This indicates that the market value of a post-IPO startup company is most likely not determined solely by the amount of R&D investment, but rather by the company's ability to manage those investments efficiently. Therefore, testing the mediating role of operational efficiency is important to explain the path of innovation on market value more comprehensively.

The mediating role of operational efficiency can be explained through the resource-based view (RBV). RBV proposes that valuable resources do not automatically create competitive advantage; value emerges when firms organize and deploy those resources through effective capabilities (Barney, 1991). In this study, R&D intensity represents a strategic innovation resource, whereas operational efficiency reflects the capability to convert knowledge and technology investments into productive asset utilization. This theoretical logic explains why

innovation may not be directly valued by the market when it has not yet produced observable operational outcomes.

Based on this description, three gaps remain in the literature. First, previous studies have largely emphasized the direct effect of innovation on firm value, while the internal mechanism linking these constructs through operational efficiency remains underexplored. Second, startup research frequently focuses on early growth, venture funding, or the pre-IPO phase, even though the post-IPO phase imposes distinct demands for accountability and operational discipline. Third, limited research has integrated product innovation, operational efficiency, and market value in a single mediation model for publicly listed startups. Accordingly, this study contributes by positioning operational efficiency as the mechanism through which R&D intensity is converted into market value.

In line with this argument, this study proposes three hypotheses. H1: product innovation proxied by R&D intensity has a positive effect on operational efficiency. H2: operational efficiency has a positive effect on market value. H3: operational efficiency mediates the effect of product innovation on market value. The direct path from product innovation to market value is also estimated to determine whether the mediation is full or partial.

RESEARCH METHODOLOGY

This study uses a quantitative explanatory design to test the effect of product innovation on the market value of publicly listed startup companies, with operational efficiency as a mediating variable. The study relies on numerical secondary data obtained from audited financial statements, annual reports, and official capital-market publications. Partial least squares structural equation modeling (PLS-SEM) is used consistently because the analysis focuses on estimating direct and indirect relationships in a predictive mediation model (Hair et al., 2021).

The population comprises startup and technology-oriented companies that conducted an initial public offering and remained listed during 2021–2025. Purposive sampling required each company to: (1) be classified as a startup or innovation-driven growth company; (2) remain actively listed throughout the observation period; (3) publish complete annual financial statements and annual reports; and (4) disclose the information required to calculate R&D intensity, asset turnover, Tobin's Q, firm size, IPO age, and leverage. Six companies met all criteria. With five annual observations per company, the final analytical sample consisted of 30 firm-year observations. The unit of analysis is the company, while the unit of observation is the firm-year.

The data used are secondary data obtained from annual financial statements, annual reports, annual governance reports, and market data available on the company's official website and stock exchange. The use of secondary data is judged appropriate because the research variables can be objectively measured, documented, and verifiable. In addition, the use of panel data allows researchers to observe the company's behavior more consistently over time after the IPO, thus providing a stronger basis in explaining the formation of the market value of go-public startups.

The independent variable in this study is product innovation proxied with R&D intensity. R&D intensity is measured using the ratio of research and development expenditures to total sales. This ratio was chosen because it can describe the level of commitment of a company in funding innovation activities relative to its main business activities. The higher the value of this ratio, the greater the intensity of the company in developing its products, technologies, and innovative capabilities. In this study, R&D intensity is formulated as:

RDI = Total R&D Cost / Total Sales

The mediation variable is operational efficiency, which in this study is proxied by asset turnover. This proxy was chosen because it is more stable and easier to compare between

companies than other efficiency indicators that are strongly influenced by sectoral cost structures. Asset turnover reflects the company's ability to generate sales from the total assets it owns, so the higher the value indicates the more efficiently the company utilizes its economic resources in operations. The measurement formula is:

OE = Total Sales / Total Assets

The dependent variable is the market value of the company, which is measured using Tobin's Q. This variable was chosen because it is able to represent investors' perception of the company's future growth prospects and value creation. Tobin's Q is formulated as:

TQ = (Equity Market Value + Total Liabilities) / Total Assets

The market value of equity is obtained from the year-end closing share price multiplied by the number of outstanding shares. The higher the Tobin's Q value, the better the market assessment of the company.

To reduce estimation bias, this study also used control variables, namely company size, company age since IPO, and leverage. Company size is measured by the natural logarithm of total assets, the age of the company is calculated from the difference between the observation year and the IPO year, while leverage is measured using the ratio of total liabilities to total assets. These three variables were chosen because they have the potential to affect the company's innovation, efficiency, and market value.

Data analysis was performed using PLS-SEM. The procedure comprised data screening, descriptive statistics, assessment of collinearity, evaluation of the structural model through path coefficients and R-square values, and hypothesis testing using t-statistics and p-values. Because all constructs were measured using objective single-proxy financial indicators, the assessment focused on the structural model rather than a reflective measurement model. The direct paths estimated were R&D intensity to operational efficiency, operational efficiency to Tobin's Q, and R&D intensity to Tobin's Q.

$$OE_it = \alpha + \beta1\ RDI_it + \beta2\ GOV_it + \beta3\ SIZE_it + \beta4\ AGE_it + \beta5\ LEV_it + e_it$$
$$TQ_it = \alpha + \beta1\ RDI_it + \beta2\ OE_it + \beta3\ SIZE_it + \beta4\ AGE_it + \beta5\ LEV_it + e_it$$
$$OE_it = \alpha + \beta1\ RDI_it + \beta2\ GOV_it + \beta3\ (RDI_it \times GOV_it) + \beta4\ SIZE_it + \beta5\ AGE_it + \beta6\ LEV_it + e_it$$

The mediation effect was tested using the Sobel test based on the estimated indirect path from R&D intensity to market value through operational efficiency. A p-value below 0.05 indicates a statistically significant indirect effect. The type of mediation is determined by considering both the indirect effect and the direct path from R&D intensity to Tobin's Q.

Table 1. Operational Definition of Variables

Variable	Code	Type	Operational definition	Proxies	Formula	Scale
Product Innovation	RDI	Independent	The level of commitment of the company in research and development activities	R&D intensity	R&D Cost / Total Sales	Ratio
Operational Efficiency	OE	Mediation	The company's ability to leverage assets to generate sales	Asset turnover	Total Sales / Total Assets	Ratio

Variable	Code	Type	Operational definition	Proxies	Formula	Scale
Market Value	TQ	Dependent	Market assessment of the company's prospects and value	Tobin's Q	(Equity Market Value + Total Liabilities) / Total Assets	Ratio
Company Size	SIZE	Control	The size of the company	In total assets	Ln(Total Assets)	Ratio
The Company's Age since IPO	AGE	Control	The length of time the company has been an issuer	Difference between observation year and IPO year	Observation year – IPO year	Ratio
Leverage	LEV	Control	Debt Utilization Rate	Debt ratio	Total Liabilities / Total Assets	Ratio

Source: Processed Data (2025)

RESULTS AND DISCUSSION

RESULTS

Descriptive Statistics of Research Variables

Descriptive statistics provide an overview of the characteristics of research variables in startup companies that have gone public. The results of the analysis showed that the average product innovation proxied through R&D intensity was 0.1982 with a standard deviation of 0.0922. This value shows that in general the companies in the sample still maintain innovation activities in the post-IPO period, although the level of intensity varies between companies. The minimum value of 0.0666 and the maximum value of 0.3198 indicate a difference in strategy in the allocation of resources for research and development.

Operational efficiency has an average value of 0.2741 with a standard deviation of 0.1342. This value shows that the company's ability to manage operational processes and resources is still diverse. The difference between a minimum value of 0.1366 and a maximum of 0.7255 reflects that not all post-IPO startups are able to achieve the same level of efficiency, so operational efficiency is a relevant aspect to explain the difference in performance between companies.

The market value of the company measured using Tobin's Q shows an average of 1.6740 with a standard deviation of 0.4713. An average score above one indicates that the market gives a relatively positive assessment of the prospects of publicly listed startup companies. In other words, the companies in the sample are perceived as having growth and value-creation potential above their recorded asset value.

Intervariable Correlation Analysis

The results of the correlation analysis showed that product innovation had a strong positive relationship with operational efficiency, with a correlation coefficient of 0.79. This relationship indicates that companies with higher R&D intensity tend to have better operational

capabilities. Initially, these findings provide an indication that innovation investments not only serve to produce new products, but also contribute to the improvement of the company's internal processes.

In contrast, the relationship between product innovation and market value showed only a relatively weak positive correlation, which was 0.27. This value shows that the market does not automatically reward the large investment in innovation. This means that innovation does not necessarily translate directly into an increase in company value, especially if the benefits of the innovation have not been seen operationally or financially.

Operational efficiency showed a stronger positive correlation with market value than product innovation, with a correlation coefficient of 0.47. These results indicate that companies with higher operational efficiency tend to obtain better market valuations and provide initial support for testing operational efficiency as a mediating mechanism.

Structural Model Evaluation

Evaluation of the structural model shows that the R-square value for operational efficiency is 0.620. This value means that 62.0% variation in operational efficiency can be explained by variables in the model, especially product innovation. These results show that the model has a good enough ability to explain changes in operational efficiency in startups that have gone public.

The R-square value for market value of 0.221 indicates that the model is able to explain the 22.1% variation in the company's market value. This value indicates that while innovation and operational efficiency are important factors, the market value formation of a go-public startup company is also influenced by other factors outside the model. Thus, the research model has a moderate clarity in explaining the market value of the company.

Direct Hypothesis Testing

The test results show that product innovation has a positive and significant effect on operational efficiency. The path coefficient of 0.7873 with a t-statistic value of 5.9894 and a p-value of less than 0.001 confirms that the increase in R&D intensity is followed by an increase in the company's operational efficiency. Thus, the first hypothesis is supported.

Operational efficiency also has a positive and significant effect on the company's market value. A path coefficient of 0.6894, a t-statistical value of 4.0607, and a p-value of less than 0.001 indicate that companies with better operational efficiency tend to obtain higher market valuations. Thus, the second hypothesis is also supported.

However, the direct influence of product innovation on market value is not significant. The path coefficient of 0.2778 with a t-statistic value of 0.8764 and a p-value of 0.3808 indicates that the intensity of R&D has not been able to explain the increase in market value directly. This finding indicates that the market does not necessarily appreciate innovation investment if the benefits have not been realized in operational performance or more concrete company performance.

Mediation Effect Testing

The results of the mediation test showed that operational efficiency mediated the relationship between product innovation and the company's market value. Sobel's z-statistic value of 2.5926 with a p-value of 0.0095 shows that the indirect influence of innovation on market value through operational efficiency is statistically significant. Thus, the fourth hypothesis is supported. These results show that the contribution of innovation to the formation of market value takes place more through improved operational efficiency than through direct influence.

Indirect-Effect Interpretation

The significant Sobel statistic ($z = 2.5926$; $p = 0.0095$) and the nonsignificant direct path from product innovation to market value ($\beta = 0.2778$; $p = 0.3808$) indicate indirect-only mediation. Thus, the empirical results support H3: product innovation contributes to market

value through operational efficiency rather than through a statistically significant direct effect.

Table 2. Descriptive Statistics of Research Variables

	Mean	STD	Min	Max
Innovation (R&D)	0.1982	0.0922	0.0666	0.3198
Operational Efficiency	0.2741	0.1342	0.1366	0.7255
Market Value (Tobin's Q)	1.6740	0.4713	1.2116	2.7177

Source: Processed Data (2025)

The average Innovation (R&D) rate of 0.1982 indicates the investment of the post-IPO strategy. Tobin's Q averaged 1.6740 indicates a positive market perception of startup growth assets.

The descriptive statistics table provides an overview of the startup data profile after Go-Public. The Average Innovation of 0.1982 reflects the company's commitment to new product development. The variation in standard deviation shows the heterogeneity of strategies between startups. Meanwhile, Tobin's average Q value of 1.6740 confirms that the capital market tends to give a premium valuation to technology-based companies.

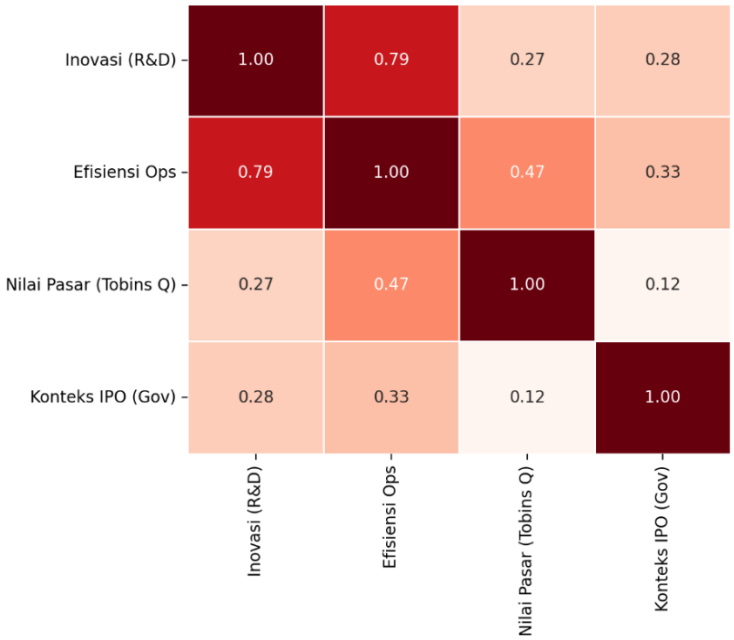


Figure 2. Correlation Matrix

The correlation matrix presents the relationships among product innovation (R&D intensity), operational efficiency, and firm market value (Tobin's Q). It provides an initial overview of the direction and strength of the relationships before structural-model testing.

The correlation results showed that product innovation (R&D) had a strong positive relationship with operational efficiency, with a correlation coefficient of 0.79. This value indicates that go-public startups with a higher level of R&D intensity tend to have better operational efficiency. This strong relationship shows that there is a close relationship between innovation activities and the company's ability to manage its operational processes.

Furthermore, the relationship between product innovation (R&D) and the company's market value (Tobin's Q) showed a positive correlation with a coefficient of 0.27. This correlation value is relatively weak to moderate, indicating that increased investment in

innovation is related to an increase in market value, but the relationship is not very strong bivariately. These findings provide an early indication that the market is not solely responding to the magnitude of R&D investments, but may consider other factors in assessing startups post-IPO.

Operational efficiency shows a stronger positive relationship with the company's market value than product innovation, with a correlation coefficient of 0.47. These results indicate that companies with higher levels of operational efficiency tend to obtain better market valuations. This correlation confirms the importance of operational efficiency as a factor related to investors' perception of the company's value.

Overall, this correlation matrix shows that operational efficiency has a stronger correlation with market value than product innovation directly. In addition, a strong relationship between innovation and operational efficiency provides an early indication that operational efficiency has the potential to play a role as a connecting variable in the relationship between product innovation and a company's market value. These descriptive findings form the initial basis for more complex relationship testing at a later stage of analysis.

The heatmap visualization clarifies this interconnection pattern, becoming the foundation for more complex causality relationship testing through Structural Equation Modeling (SEM).

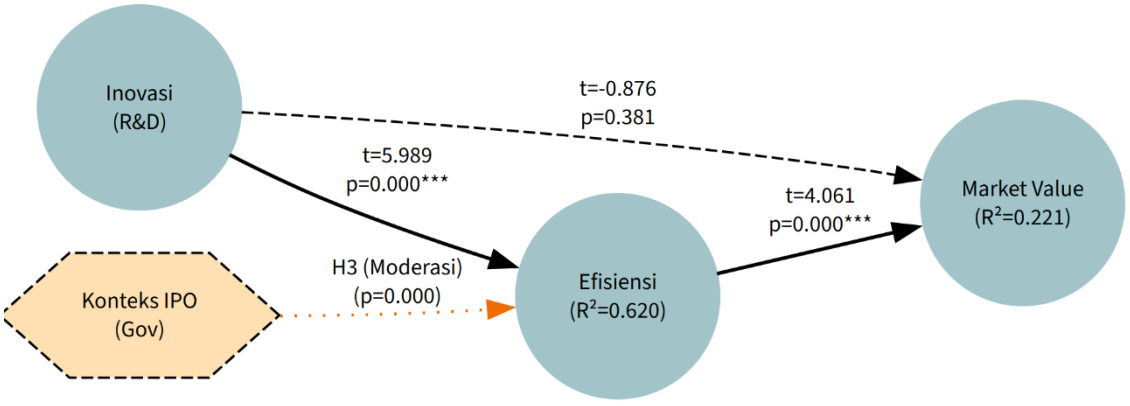


Figure 3. Inner Model Images

Table 3. Direct-Effect Hypothesis Testing

Relationship Pathway	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Innovation -> Efficiency	0.7873	0.7913	0.1314	5.9894	< 0.001
Efficiency -> *Market Value*	0.6894	0.7054	0.1698	4.0607	< 0.001
Innovation -> *Market Value*	0.2778	0.2651	0.3170	0.8764	0.3808

Source: Data processed (2026)

The Inner Model evaluation shows the predictive power of the model with an R-Square Efficiency value of 0.620 and a Market Value of 0.221. The results of the path hypothesis test

(H1) show that R&D Intensity has a significant influence on Operational Efficiency (P-Value=0.0000). These findings support the premise that innovation investment directly enhances a company's operational capabilities (Chang et al., 2024).

Table 4. Indirect-Effect Hypothesis Testing (Innovation → Market Value)

Types of Mediation	Z-Statistic	P-Value
Indirect Effect (Sobel)	2.5926	0.0095

Source: Data processed (2026)

DISCUSSION

The Influence of Product Innovation on Operational Efficiency

The results of the study show that product innovation proxied through R&D intensity has a positive effect on operational efficiency. These findings confirm that innovation investment not only produces outputs in the form of product development, but also contributes to improving the quality of internal processes, organizational learning, and the effectiveness of resource utilization. In the context of go-public startups, R&D intensity can be understood as a form of strategic investment that allows companies to improve workflows, adopt new technologies, and strengthen organizational capacity to support more structured growth.

These findings support a resource-based view that views innovation as a strategic resource for the company. However, these resources will only be valuable if they can be processed into capabilities that improve internal performance. In this case, operational efficiency can be understood as a manifestation of the company's ability to convert knowledge, technology, and innovative experiments into more productive processes. The results of this study are consistent with the studies of (Chang et al., 2024) and (Wulandari & Onuegbu, 2024) which affirm that R&D investment can improve operational efficiency through strengthening absorptive capacity, technology adoption, and more effective strategy management.

In a managerial context, these findings suggest that startups that have entered the capital market need to ensure that spending on R&D does not stand alone as a symbol of growth, but is truly integrated with the organization's efficiency agenda. Management needs to build processes that allow the results of innovation to translate into product design improvements, business process simplification, and improved quality of operational decisions. Thus, innovation becomes not only a long-term cost, but also a source of internal improvement that the company immediately feels.

The Effect of Operational Efficiency on Market Value

The results of the study show that operational efficiency has a positive effect on the market value of the company. These findings show that investors view operational efficiency as an important indicator in assessing the quality of startups that have gone public. Efficient companies tend to be perceived as having better ability to maintain productivity, control costs, and create more stable cash flow prospects. This condition increases market confidence in the sustainability of the company's business model.

From the perspective of signaling theory, operational efficiency is a signal that is easier to observe by the market than innovation commitments that are still potential. Investors tend to value efficiency as proof that the company is not only aggressive in growing, but also mature in running its business operations. This is especially important for post-IPO startups, as companies in this phase are under more intensive public scrutiny and are required to prove that their growth strategies can be translated into sustainable performance.

In practical terms, these results confirm that startups that want to increase market valuation are not enough to just enlarge the scale of their business or strengthen their innovative

image. The company must also be able to demonstrate high operational discipline. Investors seem to respond more to companies that can strike a balance between growth and efficiency, so operational efficiency becomes an important element in a company's value creation strategy.

The Direct Influence of Product Innovation on Market Value

The findings of the study show that the direct influence of product innovation on market value is not significant. These results show that the market does not necessarily give a higher valuation simply because the company has a large R&D intensity. In the context of go-public startups, innovation investment still contains high uncertainty because the results are not always quick to see, take time to commercialize, and can cause cost pressures in the short term.

Thus, the intensity of R&D is not enough to be the basis for investor assessment if it is not accompanied by evidence that the investment provides real results for the company.

These findings are consistent with research by (Ghafar Ali et al., 2025) and (Kumari & Mishra, 2021) which showed that R&D investments can suppress short-term profitability and are not always directly reflected in the company's value. These results also reinforce the view that the relationship between innovation and market value is nonlinear and highly dependent on the context of implementation and the company's ability to manage such innovations. In other words, the market does not simply assess the size of innovation inputs, but rather considers how the innovation is transformed into credible economic outcomes.

Theoretically, these results show that innovation as a strategic resource does not automatically produce firm value. Innovation requires supporting capabilities so that it can be turned into a meaningful signal for the market. Therefore, post-IPO startups need to be careful about building the narrative that increased R&D is always synonymous with increased company value. What is more important is to show the path of conversion of innovation into outcomes that investors can observe.

The Role of Operational Efficiency Mediation

The most important finding in this study is the proven role of operational efficiency mediation in the relationship between product innovation and market value. These results show that new innovations contribute to market value when companies are able to translate them into better operational efficiencies. In other words, operational efficiency is a connecting mechanism that explains how R&D investments can create market appreciation.

These findings enrich the literature on innovation and corporate finance because they show that the influence of innovation on market value is indirect. Companies can invest large funds in R&D activities, but without improved operational efficiency, the market will not necessarily respond positively. Conversely, when the results of innovation improve asset utilization, reduce inefficiencies, and strengthen operational stability, markets tend to seize on it as a more credible growth signal. These findings are in line with the argument that the success of innovation is not only measured by the amount of investment, but also by the capacity of the organization to manage and commercialize it.

From a managerial perspective, these results contain strong implications that the post-IPO startup innovation strategy must be directed at creating measurable operational benefits. Management needs to ensure that the R&D agenda is connected to process improvement, cost efficiency, and organizational productivity. Investors seem to value innovations that are able to strengthen the quality of operations more than innovations that are only big on the expense side. Thus, operational efficiency is an important bridge between innovation ambition and market value creation.

Theoretical Implication of the Mediation Mechanism

The mediation result supports the RBV argument that strategic resources create value only when they are deployed through organizational capabilities (Barney, 1991). R&D intensity represents the firm's commitment of resources to innovation, while operational efficiency demonstrates its capability to translate those resources into productive outcomes. The

nonsignificant direct path confirms that innovation expenditure alone is not sufficient to increase market valuation.

For post-IPO startups, this mechanism is particularly relevant because investors can observe asset utilization and operating outcomes more readily than the uncertain future benefits of R&D. Consequently, managers should connect R&D programs with measurable process improvements, productivity targets, and asset-use indicators so that innovation produces credible operational evidence for the market.

CONCLUSION AND RECOMMENDATION

CONCLUSIONS

This study concludes that product innovation represented by R&D intensity does not directly increase the market value of publicly listed startup companies ($\beta = 0.2778$; $p = 0.3808$). Instead, product innovation has a positive and significant effect on operational efficiency, and operational efficiency subsequently has a positive and significant effect on Tobin's Q. Therefore, innovation contributes to market value indirectly when R&D investment is converted into measurable operational improvements.

Operational efficiency functions as an indirect-only mediator between product innovation and market value (Sobel $z = 2.5926$; $p = 0.0095$). This finding contributes to the literature by clarifying that R&D intensity is a strategic input rather than an automatic source of market value. For managers, innovation budgets should be linked to asset utilization, process productivity, and operational discipline. For investors, R&D expenditure should be assessed together with evidence that the company can translate innovation into efficient operations.

RECOMMENDATIONS

Based on these limitations, further research is recommended to use more diverse innovation proxies, such as the number and quality of patents, the success rate of new product launches, or the expenditure of non-R&D innovations, in order to obtain a more comprehensive picture of the role of innovation in the creation of market value. In addition, the measurement of operational efficiency can be enriched by alternative approaches, such as data envelopment analysis (DEA), technology-based productivity indicators, or process quality variables and operational management.

Future research may also include other variables that have the potential to influence the relationship between innovation, efficiency, and market value, such as corporate governance, the quality of financial reporting, digitalization strategies, or the role of venture capital and institutional ownership. Expanding the research context to pre-IPO startups, cross-industry sectors, or cross-country comparisons will also provide a broader understanding of the dynamics of innovation and company value. Thus, further research is expected to be able to deepen and expand the findings of this research and make a stronger contribution to the development of innovation management theory and practice in the digital economy era.

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